Community-Acquired Pneumonia: Hospital Outcomes in California, 1999-2001

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Table of Contents

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Community-Acquired Pneumonia in California, 1999-2001

The California Hospital Outcomes Program (CHOP) is an initiative mandated by the State of California, and conducted by the Office of Statewide Health Planning and Development (OSHPD), to develop public reports comparing hospital outcomes for selected conditions treated in hospitals throughout the state. Over the last decade, CHOP has reported hospital mortality rates for heart attack (www.oshpd.ca.gov). Community-acquired pneumonia (CAP) was selected for reporting because –like heart attack—it is common, it is associated with a substantial mortality rate, and because its timely diagnosis and treatment are associated with improved outcomes.

This is the first published CHOP report to make use of the "Condition Present at Admission" (CPAA) and "Do Not Resuscitate" (DNR) discharge data fields that are now being collected by OSHPD. These data fields allow for improved risk adjustment.

Pneumonia is a serious infection or inflammation of the lungs. Various bacteria, viruses, mycoplasmas, and other infectious agents such as fungi or chemicals are its general causes (see American Lung Association's Web site at www.lungusa.org/diseases/lungpneumoni.html). Pneumonia may be classified into four types, depending on how and where it is acquired, (see: Mayo Clinic's Web site at www.mayoclinic.org):

1. **Community-acquired pneumonia** is acquired in the course of normal daily life;
2. **Hospital-acquired pneumonia** is acquired while hospitalized for an illness or surgical procedure;
3. **Aspiration pneumonia** may occur when foreign matter is inhaled (aspirated) into the lungs; and
4. **Pneumonia caused by opportunistic organisms** strikes people with compromised immune systems (such as persons with AIDS or with sickle cell disease).

In 2000, pneumonia resulted in 1.3 million emergency department visits and 1.3 million hospitalizations in the United States. (See: American Lung Association's Web site at www.lungusa.org/diseases/lungpneumonia.html.) During that same year, an estimated 63,548 people in the United States died from pneumonia. (See: National Center for Health Statistics' Web site at http://www.cdc.gov/nchs/fastats/pneumonia.htm.) Together, pneumonia and influenza are the seventh leading cause of death in the United States, and the fifth leading cause of death among people over 65 years of age. (See: National Foundation for Infectious Diseases' Web site at http://www.nfid.org/factsheets).

As shown in Figure 1 on the next page, hospitalizations for community-acquired pneumonia in California for 1999, 2000 and 2001 varied by season, with admissions rising in winter months and then falling during summer months. For the three years covered by the present report, more than 200,000 adult patients were admitted to 406 California hospitals because of community-acquired pneumonia. Approximately one out of eight of these patients (12.23 percent) died within 30 days of admission.

Figure1:

Community-Acquired Pneumonia Admissions in California, January 1999 - November 2001
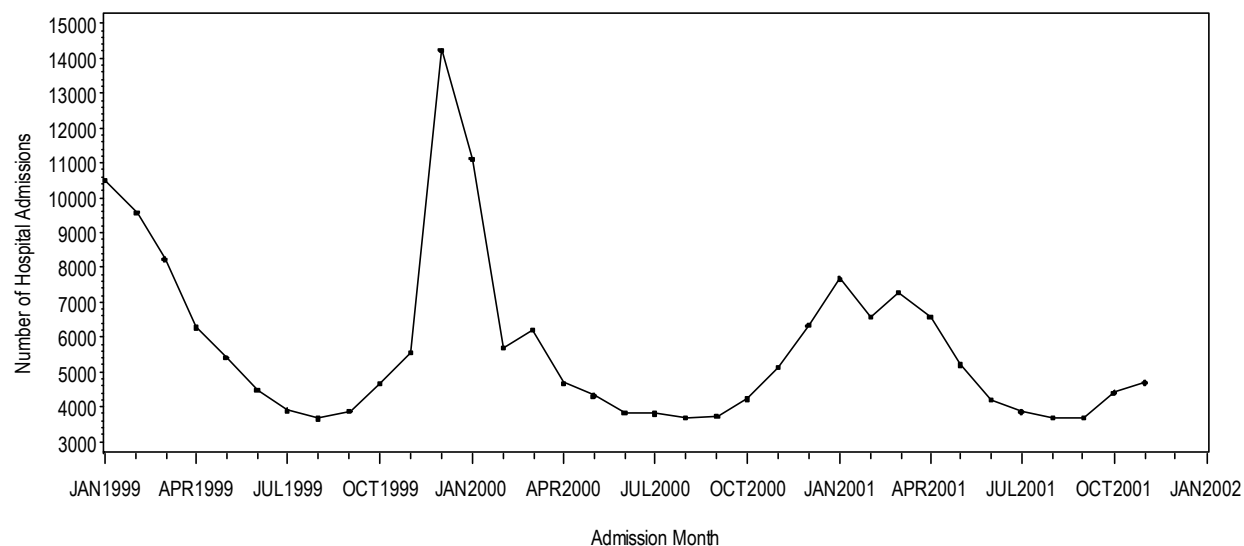
This report incorporates improvements in the risk-adjustment methodology introduced in the heart attack outcomes reports that preceded it, including:

- Linking hospital records with Vital Statistics records to ascertain deaths occurring outside the hospital; and
- Using six months of pre-CAP hospital records to more completely measure patient risk factors.

The final version of this report will be available on the Internet at: **www.oshpd.ca.gov**

A copy of the final version will also be available by contacting:

Office of Statewide Health Planning and Development
Healthcare Information Resource Center
818 K Street, Room 500
Sacramento, CA 95814
(916) 322-2814

Frequently Asked Questions:

Q: What is the time period covered in this report?

A: The report is based on hospital discharge data collected for 1999, 2000 and 2001. Results aggregated across all three years are presented in the Technical Appendix.

Q: How many hospitals were included in the study?

A: 1999: 400 hospitals
2000: 389 hospitals
2001: 382 hospitals
The number of hospitals varied for each year due to hospital closures and openings, as well as increases or decreases in admissions for community-acquired pneumonia that met the selection criteria of this report. Overall, 406 different hospitals were represented for at least one of the three years of the report.

Q: What was the 30-day rate of death for the 3-year time period?

A: The 203,028 patients admitted (from home only) for community-acquired pneumonia and meeting the inclusion and exclusion criteria of this report exhibited a 30-day death rate of 12 percent. In other words, one out of eight adult patients hospitalized for community-acquired pneumonia died within 30 days of being admitted to a California hospital. For hospitals that admitted more than 100 patients for community-acquired pneumonia during the 3-year time period, the risk-adjusted death rates varied from a low of 5 percent to a high 23 percent.

Q: How does this report differ from previous outcomes reports?

A   In an effort to remove redundancy, and to make it easier to read, this report is published in a single electronic volume instead of four separately bound volumes. Also, for the first time, a newly collected measure of a "do not resuscitate (DNR) order within 24 hours after admission" was added to an outcome report's pool of risk factors. A newly collected measure of "condition present at admission" (CPAA) was used to distinguish comorbidities present at admission from complications occurring after admission.

GLOSSARY OF FREQUENTLY USED ACRONYMS

CAP = Community-Acquired Pneumonia
CHOP = California Hospital Outcomes Program
CI = Confidence Interval
CPAA = Condition Present at Admission
CVA = Cardiovascular Accident (stroke)
DNR = Do Not Resuscitate
ICD-9-CM = International Classification of Disease – 9th Revision – Clinical Modification
OSHPD = Office of Statewide Health Planning and Development
PDD = Patient Discharge Data

Using This Report

This report is intended for everyone interested in hospital performance for the treatment of community-acquired pneumonia. This may include hospital staff, employers, government agencies, health plans, insurance companies, other healthcare purchasers and payers, as well as individual consumers.

Hospitals

The *Report on Hospital Outcomes for Community-Acquired Pneumonia* compares community-acquired pneumonia mortality rates for all California hospitals after adjusting for differences in patients' age, sex, and physical health. One of the primary purposes of the report is to improve the quality of care in *all* California hospitals by encouraging members of the medical and nursing administrative staff and other hospital staff to incorporate this information into their quality management activities.

To familiarize yourself with the way this report was created, refer to the information in the Technical Appendix that summarizes the risk-adjustment methodology and results. The last section of this report –"Mortality Results"– lists all hospitals with outcomes that were significantly better or significantly worse than the state average. (Chart 1 in the Technical Appendix may also be used to compare   your specific hospital's risk-adjusted mortality rates with the statewide benchmark and with other hospitals within the same county.) To determine if quality improvement interventions are successful compare the figures in this report with subsequent reports.

Employers and Healthcare Purchasers

This information can be useful for employers to select and negotiate insurance carriers. The information can also be passed on to employees to assist in selecting a health plan.

Government Agencies

This report can be useful to state and county agencies arranging care for program beneficiaries. Results may be used in selecting hospitals and in negotiating with managed care organizations.

Health Plans and Healthcare Payers

This report can be a guide in the selection of hospitals to provide services to beneficiaries. Appendix 1 on page 12 of the *Technical Appendix* was designed to help understand how the study was done and how results were calculated.

Individuals

This information can be used in discussions with family members, physicians, health plans, or employers to understand choices in hospital care. It can be used to make informed choices and help individuals in selecting a hospital in the event of contracting community-acquired pneumonia.

Evaluating Hospital Quality

Although this report focuses on outcomes, there are many ways of measuring healthcare quality. No single method is universally accepted as superior. However, some methods are better suited to answering specific types of questions.

Measuring Healthcare Quality

Quality is often measured simply by asking patients if they find care satisfactory. The difficulty with this type of evaluation is that patients have little clinical information upon which to base their judgments. **Patient satisfaction** may be a result of such things as personal interactions with physicians and nurses, the appearance of the facilities, and other factors not necessarily indicative of medical expertise or clinical quality. More sophisticated surveys, including some conducted in California (e.g. "PEP-C", the Patient Evaluation of Performance in California survey, available at www.chcf.org), ask patients to report on **specific aspects of care**. These reports can capture dimensions of quality such as involvement in decision-making and providers' ability to communicate that are unavailable from other sources.

Another common way of evaluating healthcare quality is to examine the hospital's staff, equipment, and facilities. These attributes are called the **structure of care.** For example, one might look at staff credentials, staff-to-patient ratios, or the availability of specialized services. Although these characteristics are important and relatively easy to measure, they tell more about the care patients *might* receive than the care patients *actually* receive.

Some quality assessment techniques directly measure the care that is received. This approach evaluates the **process of care**, which includes such things as diagnostic accuracy and the appropriate use of drugs, tests or treatments. This type of quality evaluation can be particularly useful to doctors, nurses, and hospitals even though the most appropriate care is not always easily defined or agreed upon. Process of care measures can be controversial, and also difficult for non-clinicians to interpret.

The above methods fall short of answering the question that is most important to patients - "Which hospital or doctor is most likely to make me better?" Answering this question requires measuring the **outcome of care**. Although measurement of outcomes seems to provide the most direct answers to questions about healthcare quality, it is perhaps the hardest to measure. Positive outcomes, such as improved health or improved ability to do everyday tasks, are common but can be difficult and costly to measure. Adverse outcomes, such as illnesses that develop during a hospital stay, disability, or death are much less frequent. However, such adverse outcomes are easier to directly measure from records that hospitals and government agencies already gather as administrative records. Perhaps the easiest and most reliable adverse outcome to measure is death, but the others are also important to consider.

The mortality outcomes published in this report are useful for comparing the quality of care among California hospitals because:

- **They have been risk-adjusted.** Patient age, gender, and selected diseases were used to adjust for differences in patient risk at the time of hospital admission. While this set of risk factors was limited to information contained in the administrative data file, it represents an effort to allow readers to meaningfully make apples-to-apples comparisons of how hospitals perform for patients with this condition.
- **They have been validated.** A validation study that examined 1,230 medical charts of patients admitted for community-acquired pneumonia at 82 California hospitals during 1996 showed that variations in how hospitals report data to OSHPD did not significantly affect the risk-adjusted death rates. Also, in general, low-mortality hospitals treat community-acquired pneumonia more aggressively than high-mortality hospitals.

This report evaluates death rates within 30 days following hospital admissions for community-acquired pneumonia. If one hospital receives sicker patients than another hospital, it would be expected to have more pneumonia-related deaths. Adjusting for patient characteristics helps to compare all hospitals with a statewide benchmark. Comparisons of hospitals only on their "observed" (i.e. unadjusted) death rates are difficult to interpret because different hospitals might treat different types of patients. A technique called **risk-adjustment** helps to account for these differences.

Because some patients, before they are admitted, have higher chances of dying within 30 days, it is important to adjust hospital outcomes for differences in the risk profile of their patients. This is similar to "crediting" hospitals for admitting higher risk patients and "debiting" them for admitting lower risk patients. In other words, in an effort to make this report's hospital comparisons fair, each hospital's outcome was "risk-adjusted" (credited or debited) depending on the presence or absence of various "risk factors" at each patient's admission.

In this report a "risk factor" is defined as a characteristic of a patient or a treatment episode that is known to be associated with the adverse outcome of death and cannot be controlled by the hospital. For example, both male sex and having lung cancer are risk factors associated with a higher chance of dying from community-acquired pneumonia. Under guidance from a clinical panel of pneumonia experts, these and other risk factors for pneumonia-related death were selected on the basis of their importance in the medical literature, as well as their demonstrated importance in predicting death using OSHPD's Patient Discharge Data and the State's Vital Statistics Records.

If a risk factor was present at the time of a patient's admission to a hospital it was considered a "comorbidity." If a risk factor was not present at admission, but developed during a hospital stay, it was considered a "complication." Because complications may indicate lack of quality in the treatment given to patients, it was not appropriate to "credit" hospitals for these occurrences. During the three years covered by this report, OSHPD collected a "condition present at admission" (CPAA) indicator for each diagnosis recorded on a patient's hospital record. The CPAA indicator, represented as either a "yes" or "no," identified if a diagnosis was a "comorbidity" (i.e. present at admission), or if it was "complication" (i.e. not present at admission). Directly measuring CPAA was important because while a few diagnoses are almost always present at admission and others are almost never present at admission, many diagnoses are impossible to accurately classify without the assistance of a CPAA indicator. By using the CPAA indicator, complications are not inappropriately used to "credit" hospitals for illness that developed during a hospital stay.

The most important strength of this report is that it uses risk-adjusted outcomes in an endeavor to create a "level playing field" on which the outcomes of different hospitals can be fairly compared. This enables healthcare purchasers and consumers to assess the relative value of the healthcare for which they pay. A principal weakness of this report is its reliance on a small set of "administrative" data elements that hospitals are required to report to the State's Patient Data Section. Such administrative data provides limited information about demographic and clinical variables. Accordingly, it is possible that some of the deaths predicted by the model used in this report were the result of unmeasured risk rather than poor hospital quality.

Risk Factors

A complete list of risk factors and their weights can be found in Tables A.12 and A.13 of the Technical Appendix. A combination of clinical expertise and statistical tests identified risk factors used in the adjustment process. This process used all information reported to OSHPD by hospitals, including patient age, sex, and a history of chronic diseases such as those shown in the list that follows.

This is the first outcomes report produced by OSHPD that uses a patient's "Do Not Resuscitate" (DNR) status as a risk factor. The presence of a DNR order in a patient's chart represents a request *not* to have cardiopulmonary resuscitation (CPR) performed if the patient's heart stops or if the patient stops breathing. OSHPD began collecting information on DNR status in 1999, the earliest year covered by this report. From 1999 to 2001, 11 percent of the 203,028 patients included in this report were recorded as having a DNR order within 24 hours of admission. DNR status was included as a risk factor in this report because it indicates underlying severe illness and because it predicts 30-day mortality.

Most Important Risk Factors for Pneumonia Outcomes:

- Male Sex
- Do Not Resuscitate (DNR) order within 24 hours of admission
- Type of Pneumonia
- Chronic Conditions, such as
  - Asthma
  - Cancer
  - Liver Disease
- Acute Conditions present within 24 hours of admission, such as
  - Respiratory Failure
  - Cerebrovascular Accident (stroke)
  - Coagulopathy (abnormal blood clotting)

Measuring Mortality

This report calculates the percent of hospital patients who died within 30 days following hospital admission for community-acquired pneumonia. It compares the death rates among California hospitals after adjusting for the fact that different patients have different chances of dying within 30 days of admission due to patient risk factors.

Data Sources

The data used in this analysis came from two different sources: Patient Discharge Data collected by OSHPD and the Vital Statistics Data collected by the California Department of Health Services. The hospital data were used to identify community-acquired pneumonia patients and their risk of mortality. The vital statistics data were used to determine which patients died within 30 days of being admitted to a hospital for CAP.

The discharge data contain information on all patients admitted to non-federal, acute care hospitals in California. It includes selected patient demographic characteristics such as age, race, and ZIP code of residence, as well as diagnoses and procedures. The information on age, diagnoses, and procedures was used to select the cases to be analyzed. The goal was to include all patients over 18 years of age that were primarily treated for community-acquired pneumonia between January 1, 1999 and December 1, 2001. Patients treated in December of 2001 were excluded because vital statistics data were lacking. Some eligible hospitals were not included in this report because patients meeting the criteria for inclusion in the analysis were not admitted.

Outcomes Rates

The risk-adjustment model described above was used to estimate each patient's probability of dying within 30 days after admission for CAP. At each hospital the total number of actual, or "observed," CAP-related deaths was compared to the total estimated, or "expected," CAP-related deaths derived by adding these probabilities. The total number of observed deaths and the total expected deaths were used to calculate risk-adjusted mortality rates for each hospital. Hospitals were rated as "better than expected," "as expected," or "worse than expected" in relationship to the statewide 30-day mortality rate for CAP.

Table 1 shows the total number of deaths and the 30-day death rate during the three-year period covered by this report. Of the 203,028 patients admitted for CAP, 24,829 (12.23 percent) died within 30 days of being admitted.

Table 1: Statewide Frequencies by Year of Discharge

Year of Discharge	Number of CAP Patients Hospitalized	Number of Deaths within 30 days of Admission	30-day Death Rate
1999	78,541	9,201	11.72 percent
2000	64,957	8138	12.53 percent
2001[1]	59,530	7,484	12.57 percent
TOTAL	**203,028**	**24,829**	**12.23 percent**

Interpreting the Results

Adequate or inadequate quality of care is one reason a hospital's community-acquired pneumonia mortality rate may be unusually high or unusually low. It is important, however, to consider other factors that may contribute to an individual hospital's results.

Unmeasured Risk

As mentioned earlier, the hospital administrative data used in this report do not identify all important clinical risk factors that may increase the risk of death. For example, potentially important clinical risk factors such as "body temperature" or "serum sodium" could not be measured using the administrative data that is the basis for this report.

Variations in Reporting

Variations in reporting practices may affect a hospital's risk-adjusted outcomes. Hospitals that neglect to report important risk factors could have risk-adjusted mortality rates that are too high. However, the community-acquired pneumonia validation study based on 1996 admissions showed that differences in hospital reporting practices explain little of the variation in risk-adjusted mortality.

Quality of Care

Hospitals designated as having better (or worse) than expected outcomes may provide a better (or worse) quality of care than those not so designated. The process of care in hospitals was not measured in this study, so the specific practices that may account for variations among hospital performances are not reported here. However, the validation study for community-acquired pneumonia suggested that there may be a difference between hospitals with low risk-adjusted

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[1] Figures for year 2001 do not include admissions for the month of December.

mortality and those with high risk-adjusted mortality: For patients without a "do not resuscitate" order, the best performing hospitals were significantly more likely to perform sputum cultures (i.e. diagnostic tests performed on samples of patients' saliva) at admission. The worst performing hospitals were less likely to perform sputum cultures at admission. However, the sputum culture is probably a marker for procedures that the validation study was unable to measure, as opposed to being an important procedure in its own right.

Limitations of the Report

This report provides information on one aspect of the quality of care at a particular hospital: the care of patients with community-acquired pneumonia. It does not address the quality of care for any other condition and should not be used as a general measure of hospital quality. Furthermore, it addresses only the outcomes of patients *hospitalized* for pneumonia. Thresholds for admission may differ among hospitals, and some patients may be sent home after an outpatient visit; Others may die at home without ever coming to the hospital. This report focuses on 30-day mortality, but does not assess other outcomes such as a patient's quality of life after discharge, or subsequent hospital readmissions. Other organizations, some of which are listed in *Appendix 3* on page 133, monitor different aspects of healthcare quality. Information from these organizations can be used to augment the results published in this report.

Mortality Results

Two models were used to estimate risk-adjusted CAP outcomes for each hospital. The first of the two models is based on the administrative data model developed by the 1996 CAP validation study. It did not include "do not resuscitate (DNR) order present within 24 hours of admission" as a risk factor. The second model includes DNR status as a risk factor.

DNR status is a strong predictor of 30-day mortality (see *Appendix 1,* page 29). Accordingly, its use in the second model often changes hospital ratings when compared to ratings based only on the first model (without DNR). However, because DNR status might measure differences in hospital treatment in addition to underlying illness severity, it is possible that the second model over-adjusts predicted mortality. At the same time, it is possible that the first model under-adjusts predicted mortality because it does not include an indicator of illness severity as a risk factor. This report's use of both models is an effort to balance the prediction error that might result from using only one model.

If the risk-adjusted mortality of a hospital was significantly *lower* than the state average using *both* models, then that hospital's mortality outcome was rated as significantly *better* than expected. If the risk-adjusted mortality rates of a hospital were significantly *higher* than the state average using *both* models, then that hospital's mortality outcome was rated as significantly *worse* than expected. If a hospital's risk-adjusted mortality was as expected according to *either* model, then that hospital was given an overall rating of *as expected*.

Table 2 summarizes the statewide distribution of hospital outcomes ratings for the three-year period covered by this report. Four out of five hospitals were rated *as expected*, with 7 percent rated *better than expected,* and 8 percent rated *worse than expected*. An additional 4 percent of the hospitals had no deaths, and had too few patients to rate. The statistical procedures used to assess statistical significance are described in the *Technical Appendix*.

Table 2: Summary of Risk-Adjusted Mortality Rates, 1999-2001

As Expected (one or both models)	332	81.77
Better than expected (p<.01 on both models)	27	6.65
Worse than expected (p<.01 on both models)	32	7.88
No deaths reported, and too few cases to rate on both models	15	3.69

Using both models, the following 27 hospitals exhibited risk-adjusted 30-day mortality outcomes that were *better than expected*:

HOSPITALS RATED BETTER THAN EXPECTED ON BOTH MODELS	
St. Rose Hospital	Alameda County
Summit Medical Center	Alameda County
Valley Memorial Hospital	Alameda County
San Ramon Regional Medical Center	Contra Costa County
Cedars-Sinai Medical Center	Los Angeles County
Centinela Hospital Medical Center	Los Angeles County
Citrus Valley Medical Center - Queen of the Valley	Los Angeles County
East Los Angeles Doctor's Hospital	Los Angeles County
Garfield Medical Center	Los Angeles County
Granada Hills Community Hospital	Los Angeles County
Monterey Park Hospital	Los Angeles County
Northridge Hospital Medical Center *	Los Angeles County
Presbyterian Intercommunity Hospital	Los Angeles County
Santa Marta Hospital	Los Angeles County
St. John's Hospital and Health Center	Los Angeles County
UCLA Medical Center	Los Angeles County
White Memorial Medical Center	Los Angeles County
Sierra Nevada Memorial Hospital	Nevada County
Alvarado Hospital Medical Center	San Diego County
Paradise Valley Hospital	San Diego County
Scripps Memorial Hospital-Chula Vista	San Diego County
Sharp Chula Vista Medical Center	San Diego County
Community Hospital of Los Gatos	Santa Clara County
El Camino Hospital	Santa Clara County
Redding Medical Center	Shasta County
Sonora Community Hospital	Tuolumne County
Simi Valley Hospital and Health Services *	Ventura County

*Hospital comments letter received. See Appendix 2.

The adjusted 30-day mortality rates of these hospitals can be viewed in Chart 1 of the *Technical Appendix*.

Using both models, the following 32 hospitals showed risk-adjusted 30-day mortality outcomes that were *worse than expected*:

HOSPITALS RATED WORSE THAN EXPECTED ON BOTH MODELS	
Clovis Community Hospital	Fresno County
Fresno Community Hospital and Med Center	Fresno County
University Medical Center	Fresno County
Kern Medical Center *	Kern County
Kaiser Foundation Hospital-Baldwin Park *	Los Angeles County
Kaiser Foundation Hospital-Bellflower *	Los Angeles County
Kaiser Foundation Hospital-Harbor City *	Los Angeles County
Santa Teresita Hospital	Los Angeles County
Anaheim General Hospital	Orange County
Coastal Communities Hospital	Orange County
Garden Grove Hospital and Medical Center	Orange County
Sutter Roseville Medical Center	Placer County
Desert Hospital	Riverside County
Kaiser Foundation Hospital-Riverside *	Riverside County
Parkview Community Hospital	Riverside County
Riverside Community Hospital	Riverside County
Riverside County Regional Medical Center *	Riverside County
San Gorgonio Memorial Hospital	Riverside County
Kaiser Foundation Hospital-South Sacramento *	Sacramento County
Sutter General Hospital	Sacramento County
Community Hospital of San Bernardino	San Bernardino County
High Desert Medical Center	San Bernardino County
Kaiser Foundation Hospital-Fontana *	San Bernardino County
Redlands Community Hospital *	San Bernardino County
Victor Valley Community Hospital	San Bernardino County
Palomar Medical Center *	San Diego County
Pomerado Hospital	San Diego County
Dameron Hospital	San Joaquin County
San Joaquin General Hospital *	San Joaquin County
North Bay Medical Center *	Solano County
Vaca Valley Hospital	Solano County
Emanuel Medical Center	Stanislaus County

*Hospital comments letter received. See Appendix 2.

The adjusted 30-day mortality rates of these hospitals can also be viewed in Chart 1 of the Technical Appendix.

If a hospital is not rated above as *better than expected* or *worse than expected*, then it either performed *as expected* on one or both models, or it had too few cases to be reliably rated. The risk-adjusted outcomes of these hospitals can also be viewed in Chart 1 of the Technical Appendix.